Illinois Commerce Commission
Docket 00-0393 on Rehearing
Covad/Rhythms/Sprint 9th Set of Data Requests
Data Request 12

Request:

Please provide copies of all documents related to NGDLC-based interference with central office based DSL services, including but not limited to the empirical study work done by SBC's Technology Research Inc. and any documents related to measurements done by SBC prior to "turning up" NGDLC-based DSL identified in the testimony of James Keown.

Response:

See attached documentation.

OFFICIAL FILE

ILL. C. [illegible] ET. NO. 00-0393

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Witness

Date 7/24/01 Reporter DeD

Person Responsible: James Keown

Proprietary and Confidential

NRIC V - Focus Group 3
Wireline Network Spectral Integrity **NRIC5FG3/2001-062**
Clearwater, FL; March 27 - 29, 2001

Contribution

Title: Additional Noise Margin Ratio
Source: SBC
Topic: Line Sharing
Distribution: Focus Group 3 - Spectrum Management Subcommittee

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1. Abstract

SBC has released an Accessible Letter to the industry giving notification that ADSL circuits served from its PRONTO Remote Terminals will use a default Additional Noise Margin Ratio[1] of 10 dB (formerly 31 dB) for the **fast data channel** (i.e. high speed data channel in the direction towards the end user). Furthermore, it states that all existing circuits will have implemented this within 1Q01. The Verification Office for SBC's first application of lowering the noise margin to 10 dB is completed. Results of fast channel (downstream) performance are discussed in this report. Test results were collected for 217 ADSL circuits. This contribution is offered for information only.

1.1 Maximum Noise Margin Ratio

ADSL modems go through initial transmission negotiation, or training, when the modems are powered up or lose synchronization. During that process the Central Office modem (ATU-C) sends tones at the maximum power level to the customer modem (ATU-R). Measurements are made at the ATU-R and sent back to the ATU-C to enable it to determine loop attenuation and signal to noise margin (NMR) for each of the tones. Attenuation and NMR are used to select which tones and power levels are best suited for a particular line. Tones that meet the NMR qualifications are designated for use on the line. If a tone's measured NMR exceeds the maximum NMR, the power on the tone is reduced until it is below the maximum NMR.

SBC has been configuring Additional NMR to 31 dB as the default in lieu of empirical studies of the effects of lowering this power figure. Field data provided to NRIC in a prior contribution, NRIC5FG3/2001-044, was the basis for the decision to set the default at 10 dB.

2 Field Studies on Maximum NMR Reduction

The Remote Terminals chosen for the verification study contained over 200 circuits. The primary intent of the verification office was to measure ADSL circuit performance changes. The downstream circuit performance parameters were pulled from the existing circuits just prior to entering the commands to reset the circuit noise margin. The circuits will automatically perform a re-synchronization. The parameters were

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[1] The Remote Terminal uses three NMR parameters: Minimum NMR, Target NMR, and Additional NMR. The usual default settings were: 0, 6, and 31. The defaults are now 0, 6, and 10. The new default maximum NMR is the sum of Target NMR plus Additional NMR, i.e. 16 dB.

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re-read immediately after the modem re-synchronization. DMT-specific data such as **Code Violations** and **Information Density** per tone are not accessible from the remote Terminals. Accessible parameters include the **Relative Capacity**, **Bit Rate**, **Noise Margin Ratio**, and **Power**. The effect of lowering the Additional NMR on these parameters is discussed in this report.

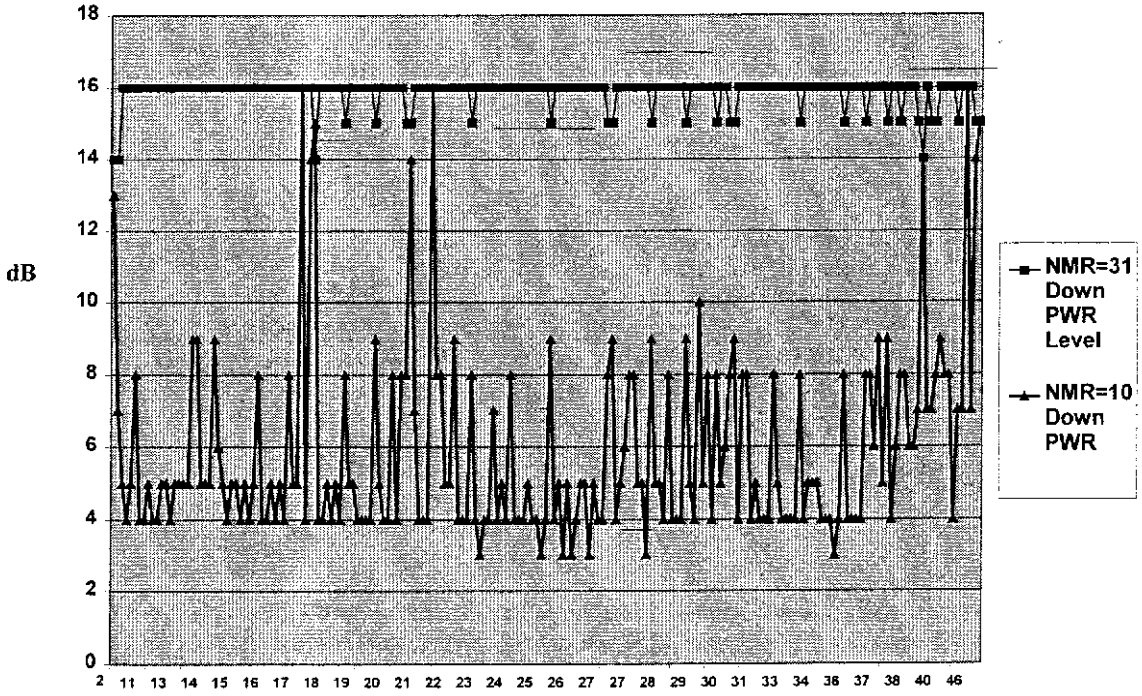
2.1 Additional NMR vs. Bit Rate

Lowering the Additional NMR did not affect the Downstream Bit Rate. The Bit Rates of each circuit was identical before and after the Additional NMR was lowered.

2.2 Additional NMR vs. Power

The Remote Terminals involved in this study can operate at a maximum downstream transmission power of 16 dBm. Power measurements before and after lowering of the Additional NMR are plotted in Figure 1 as a function of the downstream attenuation as reported by the modems. The downstream attenuation is a proxy measure for the loop length. That is, higher attenuation values are correlated to longer loops. When the Additional NMR is set to 10 dB and the modem was re-synchronized, the downstream power as reported by the ADSL modems dropped an average of 9.92 dB.

Figure 1. Plot of Downstream Power Levels Before and After Lowering the Additional NMR from 31dB to 10 dB as a function of Loop Downstream Attenuation



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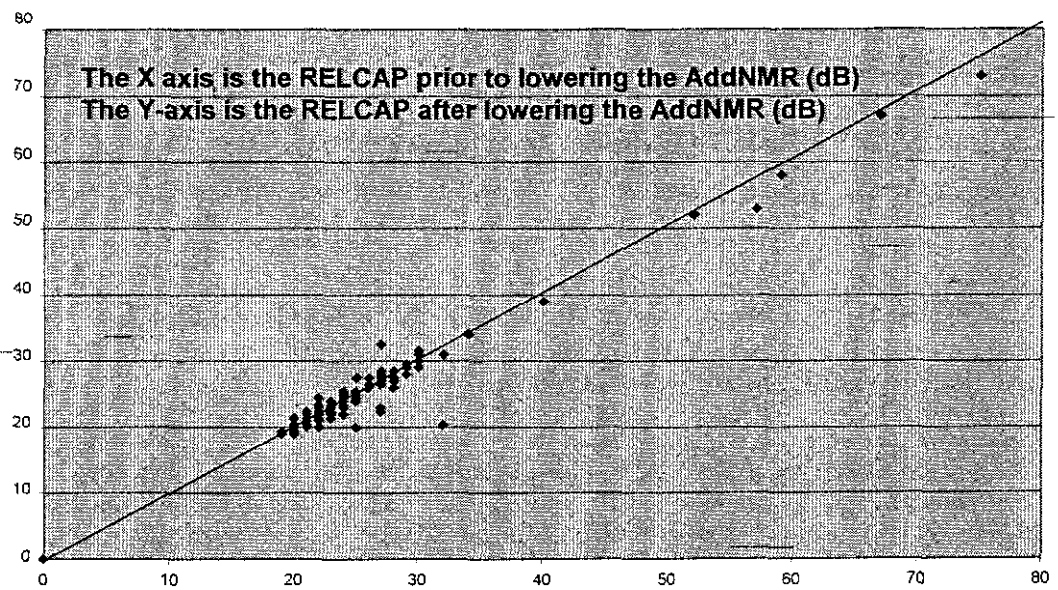
2.3 Additional NMR vs. Relative Capacity.

Relative Capacity is the percentage of the actual bit rate of the channel divided by the maximum attainable bit rate of the channel . In general, circuits operating near 6 Mbps operate near 100% of the maximum attainable bit rate and, so, have high relative capacity values. In this study 98% of all the ADSL circuits were limited by the profile settings of the circuits to a maximum downstream bit rate of 1.5 Mbps. These tend to operate in the range of 20-30% of relative capacity.

In Figure 2 the relative capacity before and after lowering of the Additional NMR is plotted. Averaged over the entire sample, there was no significant change in the relative capacity of the ADSL circuits.

Figure 2.
X,Y Scatter Plot



2.4 Additional NMR vs. Downstream Noise Margin

Noise Margin is a measure of the immunity of the channel against data error rates above one part per 10 million. The earlier SBC contribution found that the default Additional NMR of 31dB leads to marginal improvement in error rates for the power expended on many circuits. Figure 3 reveals the hoped-for effect: for circuits which were running at very high noise margin levels, the effect of lowering the Additional NMR is to reduce the noise margin towards a floor of 16 dB. 16 dB is a value reported in an earlier contribution as commensurate with marginal increase in data error rates[2].

[2] As indicated earlier the Remotes for this study do not report error rates or code violation rates.

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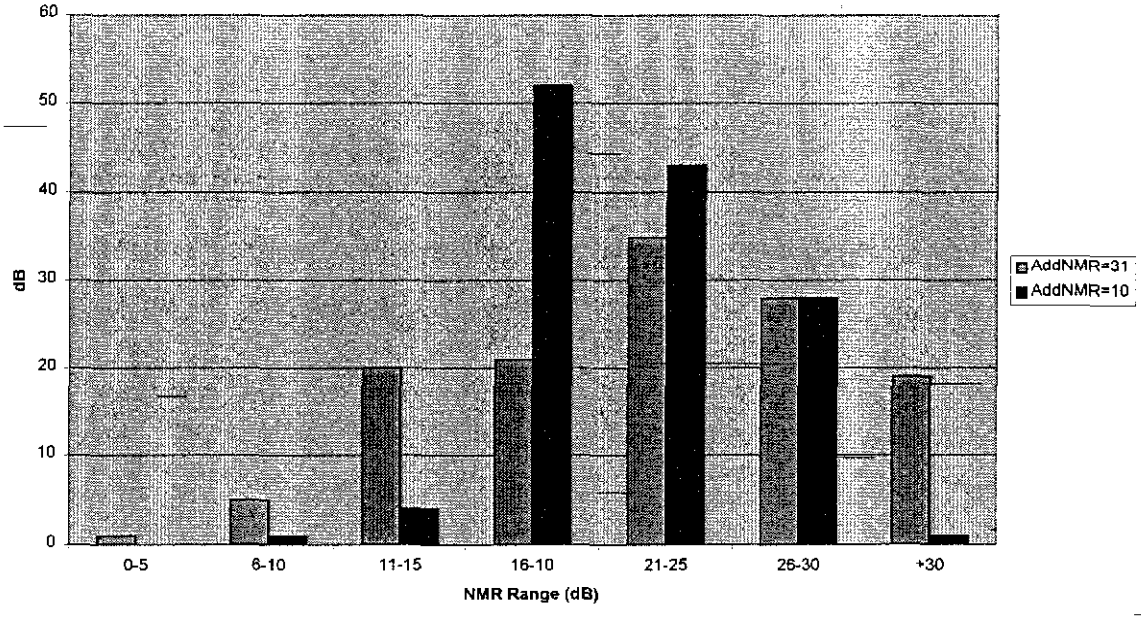
Notice also that circuits, which had previously been operating at very low noise margin levels, tended to improve after the Additional NMR was lowered. We cannot offer an explanation for this improvement at this time.

Distribution of Downstream NMR
Values represent the number of ADSL Circuits falling into the NMR Range before and after lowering the AddNMR from 31 dB to 10 dB



3 Summary

Lowering the Additional NMR of ADSL circuits served from a Remote Terminal are consistent with results of a prior SBC contribution to NRIC which tested this on circuits served from a CO-based DSLAM. The maximum attainable bit rate was relatively unaffected by reducing the Additional NMR. Consequently all circuits, whether operating at 1.5 Mbps or 6Mbps had no reduction of bit rate. Reductions in transmission power were dramatic with an average of 9.92 dB loss for the sample of 217 circuits.

Based on the circuit attenuation parameters we can surmise that the loops of this study are short compared to the maximum loop length served from remotes of about 12 kft. Lowering the Additional NMR would be expected to exhibit the greatest reduction in required power with the lowering of the Additional NMR.

Nonetheless, the average power drop of almost 10 dB can translate to substantial reduction of excess power in the loop plant from RT served ADSL circuits.

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